

BS EN 60974-7:2013



BSI Standards Publication

Arc welding equipment

Part 7: Torches

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National foreword

This British Standard is the UK implementation of EN 60974-7:2013. It is identical to IEC 60974-7:2013. It supersedes BS EN 60974-7:2005 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee WEE/6, Electric arc welding equipment.

A list of organizations represented on this committee can be obtained on request to its secretary.

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(IEC 60974-7:2013)

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Foreword

The text of document 26/492/FDIS, future edition 3 of IEC 60974-7, prepared by IEC/TC 26 "Electric welding" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60974-7:2013.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2013-11-28
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2016-02-28

This document supersedes EN 60974-7:2005.

EN 60974-7:2013 includes the following significant technical changes with respect to EN 60974-7:2005:

- new requirement for degree of protection of torch coupling device (see Table 1);
- scope is extended to cable-hose assembly connected between a power source and ancillary equipment (see Clause 1);
- torch parts, as recommended by the manufacturer, are included in the safe plasma cutting system design (see 7.4.2);
- new flammability requirement for handle material (see 11.3).

This standard shall be used in conjunction with EN 60974-1:2012.

In this standard, the following print types are used:

- *conformity statements: in italic type.*

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

This standard covers the Principle Elements of the Safety Objectives for Electrical Equipment Designed for Use within Certain Voltage Limits (LVD - 2006/95/EC).

Endorsement notice

The text of the International Standard IEC 60974-7:2013 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following note has to be added for the standard indicated :

IEC 60974-2 NOTE Harmonised as EN 60974-2.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60050	Series	International Electrotechnical Vocabulary	-	-
IEC 60529	-	Degrees of protection provided by enclosures (IP Code)	EN 60529	-
IEC 60664-1	-	Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests	EN 60664-1	-
IEC 60695-11-10	-	Fire hazard testing - Part 11-10: Test flames - 50 W horizontal and vertical flame test methods	EN 60695-11-10	-
IEC 60974-1	2012	Arc welding equipment - Part 1: Welding power sources	EN 60974-1	2012

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ARC WELDING EQUIPMENT –

Part 7: Torches

1 Scope

This part of IEC 60974 specifies safety and construction requirements for torches for arc welding and allied processes. This part of IEC 60974 is applicable to manual, mechanically guided, air-cooled, liquid-cooled, motorized, spool-on and fume extraction torches.

In this part of IEC 60974, a torch consists of the torch body, the cable-hose assembly and other components.

This part of IEC 60974 is also applicable to a cable-hose assembly connected between a power source and ancillary equipment.

This part of IEC 60974 is not applicable to electrode holders for manual metal arc welding or air-arc cutting/gouging.

NOTE 1 Typical allied processes are electric arc cutting and arc spraying.

NOTE 2 Other components are listed in Table A.1.

NOTE 3 In this part of IEC 60974, the terms "torch" and "gun" are interchangeable. For convenience "torch" has been used in the following text.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050 (all parts), *International Electrotechnical Vocabulary* (available at <http://www.electropedia.org>)

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60664-1, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60695-11-10, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

IEC 60974-1:2012, *Arc welding equipment – Part 1: Welding power sources*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050, IEC 60664-1, and IEC 60974-1, as well as the following, apply.

NOTE Additional terminology is given in Annex A.

3.1

torch

device that conveys all services necessary to the arc for welding, cutting or allied processes (for example, current, gas, coolant, wire electrode)

3.2

gun

torch with a handle substantially perpendicular to the torch body

3.3

torch body

main component to which the cable-hose assembly and other components are connected

3.4

handle

part designed to be held in the operator's hand

3.5

gas nozzle

component at the exit end of the torch directing the shielding gas around the arc and over the weld pool

3.6

non-consumable electrode

arc welding electrode which does not provide filler metal

3.7

wire electrode

solid or tubular filler wire which conducts welding current

3.8

contact tip

replaceable metal component fixed at the front end of the torch, which transfers the welding current to, and guides, the wire electrode

3.9

cable-hose assembly

flexible assembly of cables and hoses, and their connecting elements, that delivers supplies to the torch body or ancillary equipment

3.10

manual torch

torch held and guided by the operator's hand during its operation

3.11

mechanically guided torch

torch fixed to, and guided by, a mechanical device during its operation

3.12

air-cooled torch

torch cooled by the ambient air and, where appropriate, by the shielding gas

3.13

liquid-cooled torch

torch cooled by the circulation of a cooling liquid

3.14

motorized torch

torch incorporating means to supply motion to the wire electrode

3.15

spool-on torch

motorized torch incorporating a filler wire supply

3.16

arc striking and stabilizing voltage

voltage superimposed on the welding circuit to initiate or maintain the arc or both

3.17

filler metal

metal added during welding or allied processes

[SOURCE: IEC 60050-851:2008, 851-14-43]

3.18

filler wire

filler metal in solid or tubular wire form which may or may not be part of the welding circuit

3.19

plasma tip

component that provides the constricting orifice through which the plasma arc passes

3.20

visual inspection

inspection by eye to verify that there are no apparent discrepancies with respect to the provisions of the standard concerned

[SOURCE: IEC 60974-1:2012, 3.7]

3.21

plasma cutting system

combination of power source, torch, and associated safety devices for plasma cutting/gouging

3.22

plasma cutting power source

equipment for supplying current and voltage and having the required characteristics suitable for plasma cutting/gouging and which may supply gas and cooling liquid

Note 1 to entry: A plasma cutting power source may also supply services to other equipment and auxiliaries, for example auxiliary power, cooling liquid, and gas.

[SOURCE: IEC 60974-1:2012, 3.55]

3.23

torch coupling device

part of torch connecting the cable-hose assembly to the welding equipment

Note 1 to entry: A torch coupling device may include several connecting parts.

3.24

fume extraction torch

torch that incorporates means to capture the welding fumes

4 Environmental conditions

Torches shall be capable of operation when the following environmental conditions prevail:

- a) range of ambient air temperature:
 - during operation: –10 °C to +40 °C;
- b) relative humidity of the air:
 - up to 50 % at 40 °C;
 - up to 90 % at 20 °C.

Torches shall withstand storage and transport at an ambient air temperature of –20 °C to +55 °C without any damage to function and performance.

NOTE Different environmental conditions may be agreed upon between the manufacturer and the purchaser. Examples of these conditions are: high humidity, unusually corrosive fumes, steam, excessive oil vapour, abnormal vibration or shock, excessive dust, severe weather conditions, unusual coastal or shipboard conditions, vermin infestation and atmospheres conducive to the growth of mold.

5 Classification

5.1 General

Torches shall be classified in accordance with:

- a) the process for which they are designed, see 5.2;
- b) the method by which they are guided, see 5.3;
- c) the type of cooling, see 5.4;
- d) the method of striking the main arc for plasma processes, see 5.5.

5.2 Process

Torches can be designed for:

- a) MIG/MAG welding;
- b) self-shielded flux-cored arc welding;
- c) TIG welding;
- d) plasma welding;
- e) submerged arc welding;
- f) plasma cutting/gouging.

5.3 Guidance

Methods of torch guidance:

- a) manual;
- b) mechanical.

5.4 Cooling

Type of torch cooling method:

- a) ambient air or shielding gas, see 3.12;
- b) liquid, see 3.13.

5.5 Main arc striking for plasma processes

Methods for striking the main arc:

- a) by an arc striking voltage;
- b) by a pilot arc;
- c) by contact.

6 Test conditions

6.1 General

All tests shall be carried out on the same new and completely assembled torch, fitted with the cable-hose assembly normally supplied.

All tests shall be carried out at any ambient air temperature given in Clause 4, item a).

The accuracy of measuring instruments shall be:

- a) electrical measuring instruments: class 1 ($\pm 1\%$ of full-scale reading), except for the measurement of insulation resistance and dielectric strength where the accuracy of the instruments is not specified, but shall be taken into account for the measurement;
- b) temperature measuring device: ± 2 K.

6.2 Type tests

All type tests given below shall be carried out on the same sample and in the following sequence:

- a) general visual inspection;
- b) insulation resistance without humidity treatment (preliminary check), see 7.2;
- c) impact resistance, see 11.1;
- d) resistance to hot objects, see Clause 10;
- e) protection against direct contact, see 7.4;
- f) insulation resistance, see 7.2;
- g) dielectric strength, see 7.3;
- h) general visual inspection.

The heating test in accordance with 8.3 may be carried out on a separate sample and shall be followed by the coolant leakage test in accordance with Clause 9. The other tests included in this standard and not listed here may be carried out in any convenient sequence.

6.3 Routine tests

The following routine tests shall be carried out on each torch in the following sequence:

- a) general visual inspection;
- b) functional test as specified by the manufacturer, for example, leaks of fluid or gas, trigger operation.

7 Protection against electric shock

7.1 Voltage rating

Torches shall be rated according to the classification and use as given in Table 1.

Table 1 – Voltage rating of torches

Classification	Voltage rating V_{peak}	Insulation resistance M Ω	Dielectric strength V r.m.s.	Degree of protection in accordance with IEC 60529			
				Nozzle orifice	Handle	Torch coupling device ^a	Other parts ^{b, c}
Manually guided torches except for plasma cutting	113	1	1 000	IP0X	IP3X	IP2X	IP3X
Mechanically guided torches except for plasma cutting and submerged arc welding	141	1	1 000	IP0X	Not applicable	IPXX	IP2X
Mechanically guided submerged arc welding torches	141	1	1 000	IP0X	Not applicable	IPXX	IPXX
Manually guided plasma cutting torches	500	2,5	2 100	Plasma tip, see 7.4.2	IP4X	IP3X	IP3X
Mechanically guided plasma cutting torches	500	2,5	2 100	IP0X	Not applicable	IP2X	IP2X

^a Degree of protection for torch coupling device is tested while coupled.
^b Other parts are, for example, gas nozzle, neck.
^c Wire drive systems of motorized torches that are accessible to touch are not considered as other parts: IPXX.

7.2 Insulation resistance

The insulation resistance of a new torch shall, after the humidity treatment, be not less than the values given in Table 1.

Conformity shall be checked by the following test:

a) Humidity treatment

A humidity cabinet is maintained at a temperature t between 20 °C and 30 °C and a relative humidity between 91 % and 95 %.

The torch fitted with the cable-hose assembly (liquid-cooled torches without cooling liquid) is brought to a temperature between t and $(t + 4)$ °C and is then placed for 48 h in the humidity cabinet.

b) Insulation resistance measurement

Immediately after the humidity treatment, the torch handle and 1 m at each end of the cable-hose assembly are wiped clean and tightly wrapped in a metal foil covering the external surface of the insulation.

The insulation resistance is measured by the application of a d.c. voltage of 500 V between

- all circuits and the metal foil,
- and

- all wires and circuits intended to be isolated from each other within the torch.

The reading is made after stabilization of the measurement.

7.3 Dielectric strength

7.3.1 General requirement

The insulation shall withstand the test voltages of Table 1 without any flashover or breakdown.

The a.c. test voltage shall be of an approximate sine waveform with a peak value not exceeding 1,45 times the voltage of Table 1, having a frequency of approximately 50 Hz or 60 Hz. Alternatively, a d.c. test voltage of 1,4 times the r.m.s. test voltage may be used.

Conformity shall be checked by the following test:

Liquid-cooled torches are tested without cooling liquid.

The handles are tightly wrapped with a metal foil. The cable-hose assembly is placed in contact with a conductive surface throughout its entire length, for example wrapped around a metal cylinder or coiled on a flat metal surface. The metal foil and the conductive surface are electrically connected.

The full value of the test voltage is applied for 60 s between:

- a) the conductive surface and each isolated circuit;
- b) all circuits intended to be isolated from each other (e.g. trigger or other remote control circuits).

At the discretion of the manufacturer, the test voltage may be slowly raised to the full value.

The maximum permissible setting of the overload release shall be 100 mA. The high-voltage transformer shall deliver the prescribed voltage up to the tripping current. Tripping of the overload release is regarded as a failure.

7.3.2 Additional requirements for plasma cutting torches

In addition for manual plasma cutting torches the insulation between the handle and the cutting circuit shall withstand a test voltage of 3 750 V r.m.s. During the dielectric strength test of plasma cutting torches, the electrode and plasma tip connections should be electrically connected together.

Conformity shall be checked by the test given in 7.3.1.

7.3.3 Additional requirements for striking and stabilizing voltage rating

Torches intended for use with arc striking and stabilizing devices shall have an arc striking and stabilizing voltage rating.

For tungsten inert gas (TIG) and plasma arc welding torches the rated arc striking and/or stabilizing voltage shall be determined by the manufacturer.

For plasma cutting torches, the rated arc striking and/or stabilizing voltage shall be determined as follows:

- a) operate each power source expected to form a safe system (see item o) of Clause 13) according to manufacturer's recommendation, for example with proper consumables and gasses, and under single fault condition;
- b) measure the arc striking and/or stabilizing voltage at each end of the torch;
- c) the highest value measured, from all power sources operated in item a), will be the rated arc striking and/or stabilizing voltage.

The torch insulation shall withstand a test voltage without flashover or breakdown. Corona discharges are permitted.

Liquid-cooled torches may be tested without cooling liquid.

Conformity shall be checked by the following test:

The torch handle is tightly wrapped with a metal foil. The cable and hose assembly is placed in contact with a conductive surface throughout its entire length, for example wrapped around a metal cylinder or coiled on a flat metal surface. The metal foil and the conductive surface are electrically connected.

A test voltage with a peak voltage 20 % higher than the rated arc striking and stabilizing voltage is applied for 2 s between the torch electrode and the conductive surface, and between the torch electrode and other isolated circuits. This test voltage is either:

- a) high-frequency voltage of pulse width between 0,2 μ s and 8 μ s, with a repetition frequency between 50 Hz and 300 Hz; or
- b) an a.c. voltage of approximately sine waveform at 50 Hz or 60 Hz.

7.4 Protection against electric shock in normal service (direct contact)

7.4.1 Degree of protection requirements

Torches shall meet the degree of protection requirements of Table 1. In addition cable-hose assembly shall meet the degree of protection IP 3X. Torches are not intended for operation during rain or snow or equivalent conditions.

Conformity shall be checked in accordance with IEC 60529.

7.4.2 Additional requirements for plasma cutting torches

The plasma cutting torch, parts (e.g. parts typically replaced due to wear) and plasma cutting power source, recommended by the manufacturer, shall form a safe system.

Additional requirements for plasma cutting torches are given in 6.3.4 of IEC 60974-1:2012.

8 Thermal rating

8.1 General

Manual torches shall be rated at a minimum of 100 % or 60 % or 35 % duty cycle.

Mechanically guided torches shall be rated at a minimum of 100 % duty cycle.

Fume extraction torch shall be rated at the extraction flow rate defined by the manufacturer.

8.2 Temperature rise

The temperature rise of manual torches, at any point on the outer surface of the part of the handle gripped by the operator, shall not exceed 30 K.

The temperature rise of cable-hose assembly, at any point on the outer surface, shall not exceed 40 K.

After completion of the tests, the safety and operability of the torch shall not be impaired.

Conformity shall be checked by the heating test according to 8.3.

8.3 Heating test

8.3.1 General

The torches shall be loaded with all rated currents at their corresponding rated duty cycles, see 8.1.

The mean value of the d.c. current shall be taken and the electrode polarity shall be chosen in accordance with 8.3.2 and 8.3.3.

The temperature shall be measured at the hottest spot on the area of the handle, normally gripped by the operator for manual torches.

The temperature shall be measured at the hottest spot of cable-hose assembly.

The temperature measuring device(s), handle and cable-hose assembly shall be protected from draughts and radiant heat.

The torch clamping device used shall not significantly affect the test result, for example by heat loss.

Liquid-cooled torches shall be continuously cooled with the minimum flow rate and minimum cooling power as specified by the manufacturer (see item h) of Clause 13).

NOTE Cooling power is defined in IEC 60974-2.

Each heating test shall be carried out for a period of not less than 30 min and continued until the rate of temperature rise does not exceed 2 K/h.

The cycle time for test purposes shall be 10 min.

The ambient and torch temperature shall be measured simultaneously during the last 10 min in the case of continuous load (100 % duty cycle). For lower duty cycles, it shall be measured in the middle of the load period during the last cycle.

The ambient air temperature is measured by a device, located at a distance of 2 m, at the same height as the torch and shall be protected from draughts and radiant heat.

8.3.2 Metal inert/active gas (MIG/MAG) or self-shielded flux-cored arc welding torch

A metal tube of a diameter and length appropriate to the welding process, for example 400 mm in diameter and 500 mm long, is horizontally clamped into a rotating device. The inside of the tube is cooled by means of water.

The torch shall be positioned in a plane perpendicular to the tube axis in such a way that the wire electrode is 15_{-15}^0 ° to the vertical (see Figure B.1). In addition, for manually guided torches, the handle shall be positioned on the cooler side.

The torch shall be moved parallel to the centre line of the tube in order to form a weld bead.

a) Test conditions for metal inert gas arc welding (MIG) of aluminium alloys are given below and in Table 2:

- wire electrode: aluminium, 3 % to 5 % magnesium;
- type of current: d.c.;

- electrode polarity: positive;
- shielding gas: argon;
- tube material: aluminium alloy;
- load voltage and welding speed: adjusted to give a stable arc and a continuous weld pool.

Table 2 – Test values for metal inert gas arc welding (MIG) of aluminium alloys

Welding current A	Nominal diameter of the wire electrode mm	Distance between contact tip and metal tube ± 20 % mm	Maximum gas flow l/min
Up to 150	0,8	10	10
151 to 200	1	15	12
201 to 300	1,2	18	15
301 to 350	1,6	22	18
351 to 500	2	26	20
Above 500	2,4	28	20

b) Test conditions for metal active gas arc welding (MAG) of mild steel are given below and in Table 3:

- wire electrode: copper-coated mild (low carbon) steel;
- type of current: d.c.;
- electrode polarity: positive;
- shielding gas: argon/CO₂ mixed gas (15 % to 25 % CO₂);
- tube material: mild (low carbon) steel;
- load voltage and welding speed: adjusted to give a stable arc and a continuous weld pool.

If additional values for the shielding gas CO₂ are specified in the instructions for use, an additional test with this gas shall be carried out according to the test conditions given in Table 3.

Table 3 – Test values for metal active gas arc welding (MAG) of mild steel

Welding current A	Nominal diameter of the wire electrode mm	Distance between contact tip and metal tube ± 20 % mm	Maximum gas flow l/min
Up to 150	0,8	10	10
151 to 250	1	15	13
251 to 350	1,2	18	15
351 to 500	1,6	22	20
Above 500	2	26	25

c) Test conditions for metal active gas arc welding (MAG) with flux-cored wire are given below and in Table 4:

- wire electrode: rutile type;
- type of current: d.c.;
- electrode polarity: positive;
- shielding gas: argon/CO₂ mixed gas (15 % to 25 % CO₂);

- tube material: mild (low carbon) steel;
- load voltage and welding speed: adjusted to give a stable arc and a continuous weld pool.

Table 4 – Test values for metal active gas arc welding (MAG) with flux-cored wire

Welding current A	Nominal diameter of the wire electrode mm	Distance between contact tip and metal tube $\pm 20\%$ mm	Maximum gas flow l/min
251 to 350	1,2 to 1,4	25	15
351 to 500	1,6 to 2	30	18
Above 500	2,4	35	20

d) Test conditions for self-shielded flux-cored arc welding of mild steel are given below and in Table 5:

- wire electrode: type 1: a wire designed with a fast freezing slag for all-positional welding;
type 2: a wire designed for high deposition rates in flat and horizontal vertical position welding;
- type of current: d.c.;
- electrode polarity: wire electrode type 1: negative;
wire electrode type 2: positive;
- tube material: mild (low carbon) steel;
- load voltage and welding speed: adjusted to give a stable arc and a continuous weld pool.

Table 5 – Test values for self-shielded flux-cored arc welding of mild steel

Welding current A	Type of wire electrode	Nominal diameter of the electrode mm	Distance between contact tip and metal tube $\pm 20\%$ mm
Up to 250	1	Up to 1,2	20
251 to 350	2	1,6 to 2,0	50
351 to 500	2	2,4 to 3,0	50
Above 500	2	3,2 and more	60

8.3.3 Tungsten inert gas (TIG) and plasma arc welding torch

A copper block, with or without water cooling (see for example, Annex C), shall be used and the torch shall be positioned perpendicular to the upper horizontal face of the copper block (see Figures B.2 and B.3).

For plasma welding torches, the shielding gas and the gas flow shall be as specified by the manufacturer in the instructions for use.

The testing installation shall be equipped with the instruments as shown in Figure A.5.

The nominal a.c. welding currents of a torch are defined as 70 % of the nominal d.c. value.

a) Test conditions for tungsten inert gas arc welding (TIG) are given below and in Table 6:

- electrode type: tungsten alloy;

- electrode diameter: maximum for the test current as recommended by the manufacturer;
- type of current: d.c.;
- electrode polarity: negative;
- shielding gas: argon;
- load voltage: adjusted to give a stable arc and a continuous weld pool.

Table 6 – Test values for tungsten inert gas arc welding (TIG)

Welding current A	Maximum gas flow l/min	Distance between nozzle and copper block ±1 mm mm	Distance between electrode and copper block ±1 mm mm
Up to 150	7	8	3
151 to 250	9	10	5
251 to 350	11	10	5
351 to 500	13	10	5
Above 500	15	10	5

b) Test conditions for plasma welding are given below and in Table 7:

- type of current: d.c.;
- electrode polarity: negative;
- gases and gas flow: as specified by the manufacturer.

Table 7 – Test values for plasma arc welding

Welding current A	Distance between plasma tip and copper block ±1 mm mm
Up to 30	3
31 to 50	3
51 to 100	3
101 to 150	4
151 to 200	6
201 to 250	8
251 to 280	8
Above 280	10

8.3.4 Plasma cutting torch

The torch shall be tested:

- a) at the rated current with the corresponding rated duty cycle, see 8.1;
- b) with the type of gas and flow rate specified by the manufacturer;

and

- c) at the distance between plasma tip and workpiece specified by the manufacturer with one of the following test arrangements:

- 1) copper block with a hole, according to Annex D or similar (suitable for use up to 75 A): the torch shall be positioned perpendicularly to the upper horizontal face of the copper block and centred to the hole;
- 2) copper bars with a slot, according to Annex E or similar (suitable for use up to 200 A): the torch shall be positioned perpendicularly to the upper horizontal face of the copper bars, centred between them and moved about 500 mm backwards and forwards;
- 3) cutting (suitable for all currents): the torch shall be positioned perpendicularly to a mild steel sheet or tube with the maximum thickness specified by the manufacturer for the rated current. The cutting speed shall be sufficient to cut through the material. In order to reduce scrap, it is permitted to arrange the cutting so that the arc indexes approximately one kerf width per pass.

For a duty cycle lower than 100 % there shall be a new start after each stop. All cuts shall start at the edge of the steel sheet;

- 4) other means that are shown to be equivalent to 1), 2) or 3) above.

8.3.5 Submerged arc welding torch

A metal tube of a diameter and length appropriate to the welding process, for example 400 mm in diameter and 500 mm long, is horizontally clamped into a rotating device. The inside of the tube is cooled by means of water.

The torch shall be positioned in a plane perpendicular to the tube axis in such a way that the wire electrode is 15_{-15}^0 ° to the vertical (see Figure B.1). In addition, for manually guided torches, the handle shall be positioned on the cooler side.

The torch shall be moved parallel to the centre line of the tube in order to form a weld bead.

The torch shall be tested:

- a) at the rated current with the corresponding rated duty cycle, see 8.1;
 - b) with the type of wire and flux specified by the manufacturer;
- and
- c) with the type of current and the electrode polarity specified by the manufacturer.

9 Pressure of the liquid cooling system

The liquid cooling system of liquid-cooled torches shall withstand a minimum pressure of 0,5 MPa (5 bar) at a minimum temperature of 70 °C without leakage.

Conformity shall be checked by measurement and visual inspection immediately following the heating test in accordance with 8.3.

10 Resistance to hot objects

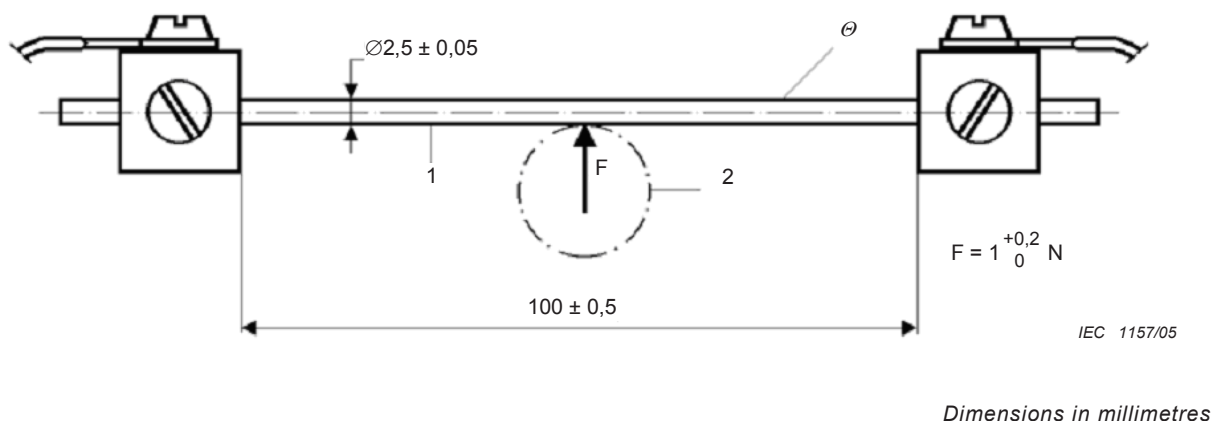
The insulation of the handle and the cable-hose assembly shall be capable of withstanding hot objects and the effects of a normal amount of weld spatter without being ignited or becoming unsafe.

This requirement is not applicable for:

- a) torch coupling device;
- b) coupling device of cable-hose assembly connected between a power source and ancillary equipment;
- c) mechanically guided torches intended to be protected in their final installation;

- d) cable-hose assembly connected between a power source and ancillary equipment when incorporated welding cable is compliant with this test;
- e) cable-hose assembly that is not a part of the welding circuit.

Conformity shall be checked with a device according to Figure 1.



Key

- 1 18/8 chrome-nickel steel θ Test temperature
- 2 Handle of the torch

Figure 1 – Device for testing the resistance to hot objects

An electric current (of approximately 23 A) is passed through the rod until a steady-state temperature θ of 250^{+5}_0 °C is reached. During the test, the temperature of the heated rod shall be maintained. This temperature shall be measured by a contact thermometer or a thermocouple. The heated rod in a horizontal position is then applied for 2 min to the insulation at the weakest points (for example, minimum insulation thickness and closest distance to live parts). The heated rod shall not penetrate through the insulation and contact live parts. The heated rod shall be applied at the portion with the minimum wall thickness and where internal live parts are closest to the surface. An attempt is made to ignite any gases which may be emitted in the region of the contact point by means of an electric spark or small flame. If the gases are flammable, the burning shall stop as soon as the heated rod is removed.

Following the test, the handle and the cable-hose assembly shall meet the requirements of Clause 7.

11 Mechanical provisions

11.1 Impact resistance

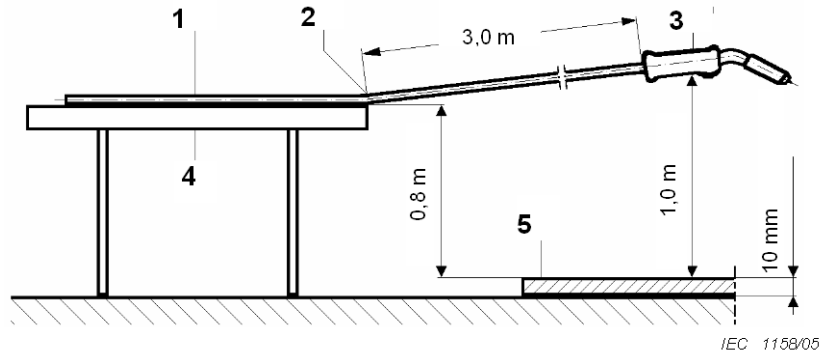
Manual torches shall have sufficient mechanical strength to ensure that, when used in accordance with the requirements, no damage occurs which will impair the safety or operability.

Fragile parts such as ceramic nozzles, etc. which, if damaged, impair the operability but not the safety may be replaced after the test.

Clause 11 does not apply to spool-on torches, mechanically guided and motorized torches.

Conformity shall be checked by the following impact test and visual inspection.

The torch at its full 3 m extension of its cable-hose assembly, is lifted to a height of 1 m, measured at the handle, i.e. 0,2 m above the level of the point where the cable-hose is fixed as shown in Figure 2.



Key

- | | |
|-----------------------|---------------|
| 1 Cable-hose assembly | 4 Table |
| 2 Fixing point | 5 Steel plate |
| 3 Torch handle | |

Figure 2 – Device for the impact test

The torch handle is released without initial velocity and allowed to fall onto a hard and rigid surface, for example a steel plate. This procedure shall be repeated 10 times and arranged so that the torch falls on different parts.

Following the test, the torch shall meet the requirements of Clause 7 and be operable.

11.2 Accessible parts

Accessible parts shall have no sharp edges, rough surfaces or protruding parts likely to cause injury.

Conformity shall be checked by visual inspection.

11.3 Handle material

Torch handles for manually guided plasma cutting torches shall have a flammability classification of HB or better in accordance with IEC 60695-11-10.

Conformity is checked by inspection of non-metallic materials specification.

12 Marking

The torch shall be clearly and indelibly marked as follows:

- a) name of the manufacturer, distributor, importer or the registered trademark;
- b) type (identification) as given by the manufacturer;
- c) reference to this standard, confirming that the torch complies with its requirements.

EXAMPLE:

Manufacturer – type – Standard

XXX – YYY – IEC 60974-7

Conformity shall be checked by visual inspection and the test given in Clause 15 of IEC 60974-1:2012.

13 Instructions for use

Each torch shall be delivered with an instruction sheet. This instruction sheet shall include, as a minimum, the following information, if applicable:

- a) process, see 5.2;
- b) method of guidance, see 5.3;
- c) arc striking and stabilizing voltage rating, see 7.3.3;
- d) rated current and corresponding duty cycle, see 8.1;
- e) type of shielding gas (for example argon, CO₂ or mixed gases with their percentage)
or,
for plasma cutting torches, type of gas, flow rate and/or operating pressure;
- f) length of the cable-hose assembly;
- g) type and diameter range of the electrode
or,
for plasma cutting torches, proper combinations of plasma tip, nozzle and electrode types;
- h) type of cooling, see 5.4;
and for liquid-cooled torches:
 - 1) minimum flow rate in l/min;
 - 2) minimum and maximum inlet pressure in MPa (bar);
 - 3) minimum cooling power in kW;and for fume extraction torches:
 - 4) extraction flow rate in m³/h;
- i) rating of electrical controls incorporated in the torch;
- j) requirements for the connection of the torch;
- k) essential information about the safe operation of the torch including environmental conditions;
- l) reference to this standard confirming that the torch conforms with its requirements;
- m) conditions under which extra precautions are to be observed (for example environment with increased hazard of electric shock, flammable surroundings, flammable products, elevated working positions, ventilation, noise, closed containers, etc.).

And additional for plasma cutting torches:

- n) maximum and minimum gas pressure at the inlet;
- o) essential information about the safe operation of the plasma cutting torch and the functioning of interlocking and safety devices, for example a list of suitable plasma arc cutting system components identified by the manufacturer, model, catalogue and/or serial number, which the manufacturer recommends for use with the system. Each component listed shall be such that it provides the level of protection to the operator (including compatibility of safety devices and/or protection circuits, no-load voltage, striking voltage and safe connection of the torch to the plasma cutting power source) as originally provided;
- p) type (identification) of plasma cutting power source or sources that can form a safe system with the plasma cutting torch.

Conformity shall be checked by reading the instructions.

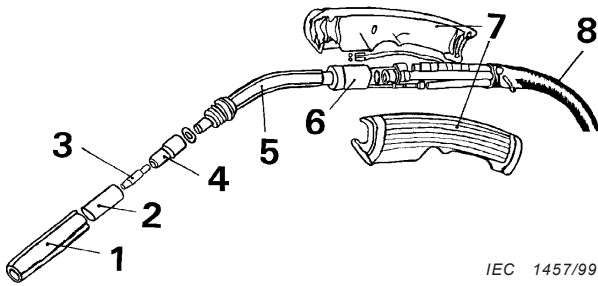
Annex A (informative)

Additional terminology

The following terms (see Table A.1) and drawings (see Figures A.1 to A.7 and B.1 to B.3), although not used in the body of this standard, are given as a useful aid to comprehend the construction and design of torches.

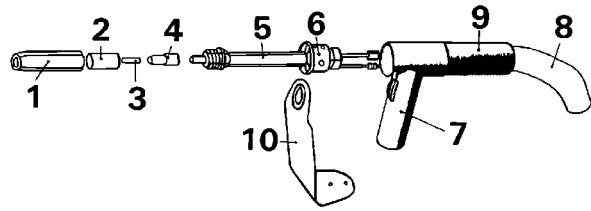
Table A.1 – List of terms

Reference in the figures of Annexes A and B	English term	French term
1	gas nozzle	buse
2	insulator	canon isolant
3	contact tip	tube-contact
4	tip adapter with or without gas diffuser	adapteur avec ou sans diffuseur de gaz
5	neck	lance
6	torch body	corps de torche
7	handle	manche
8	cable-hose assembly	faisceau
9	body housing	enveloppe de corps de torche
10	hand shield	protège-mains
11	gas lens filter	filtre de diffuseur
12	gas lens	diffuseur de gaz
13	collet body	porte-pince
14	heat shield	isolant thermique
15	collet	pince porte-électrode
16	electrode	électrode
17	back cap (short)	bouchon (court)
18	back cap (long)	bouchon (long)
19	plasma tip	tuyère
20	gas distributor	distributeur de gaz
21	gas diffuser	diffuseur de gaz
22	flow meter	débitmètre
23	thermometer	thermomètre
24	inlet pressure	pression d'entrée
25	cooling liquid	liquide de refroidissement
26	shielding gas	gaz de protection
27	plasma gas	gaz plasma
28	wire feeder	dévidoir
29	torch	torche
30	adjustment unit	dispositif de positionnement
31	metal tube	tube métallique
32	copper block	bloc en cuivre
NOTE Items 29 to 32 are shown in the figures of Annex B.		



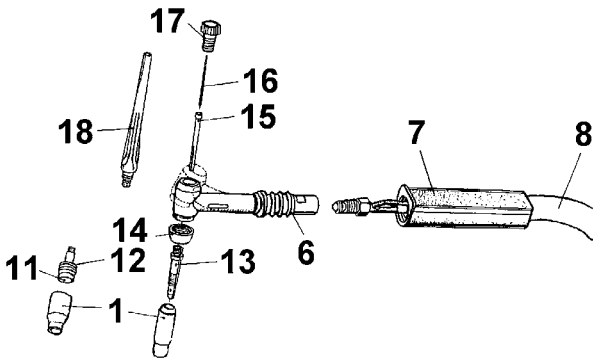
IEC 1457/99

Figure A.1 – Torch for metal inert/active gas (MIG/MAG) or self-shielded flux-cored arc welding



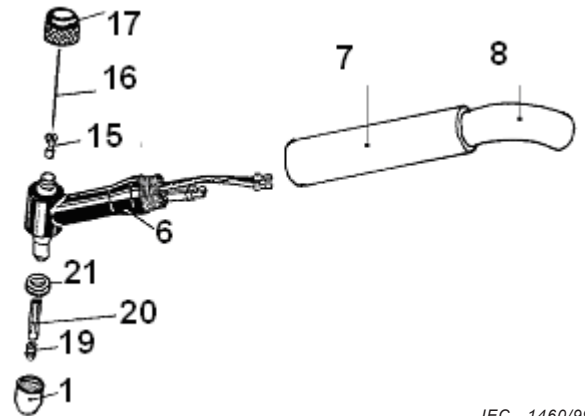
IEC 1458/99

Figure A.2 – Gun for metal inert/active gas (MIG/MAG) or self-shielded flux-cored arc welding



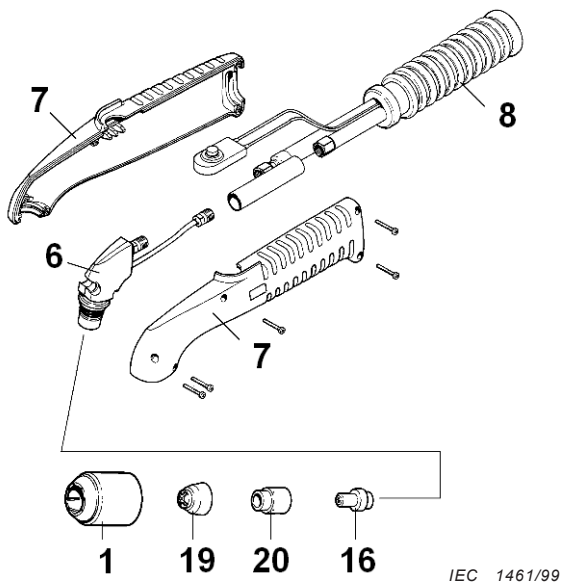
IEC 1459/99

Figure A.3 – Torch for tungsten inert gas arc welding



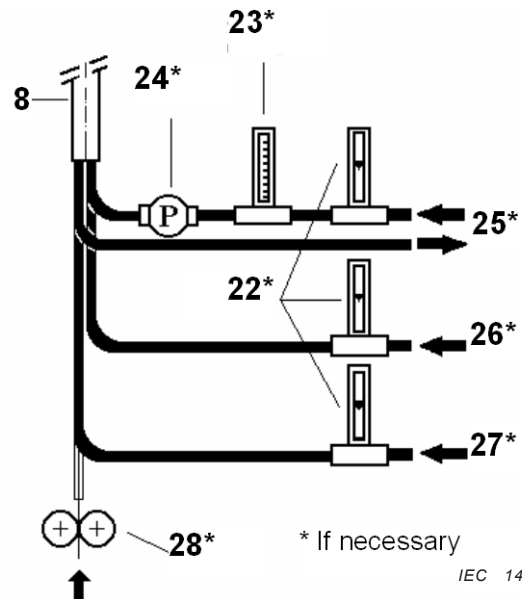
IEC 1460/99

Figure A.4 – Torch for plasma arc welding



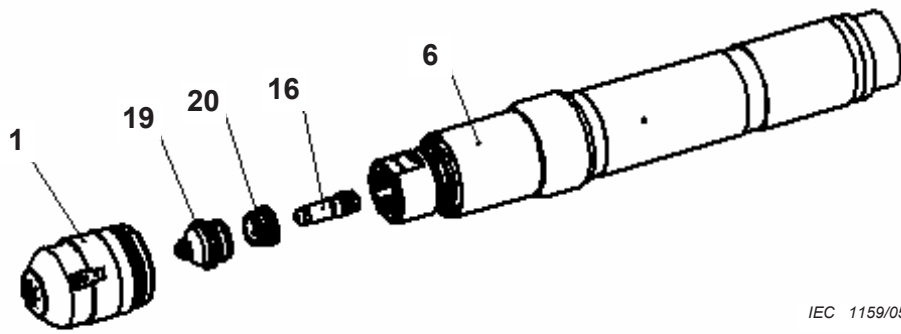
IEC 1461/99

Figure A.5 – Torch for plasma cutting



IEC 1462/99

Figure A.6 – Supply unit



IEC 1159/05

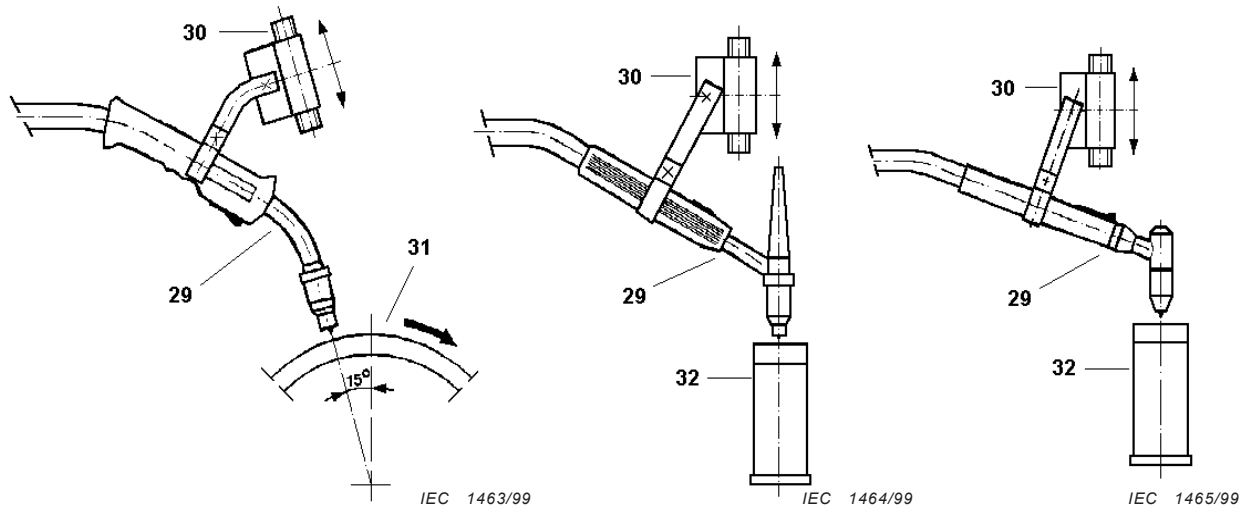
Figure A.7 – Mechanically guided plasma torch

NOTE For explanation of numbered items in the figures, see Table A.1.

Annex B (normative)

Position of the welding torches for the heating test

The position of the welding torches for the heating test is given in Figures B.1 to B.3.



NOTE For explanation of numbered items, see Table A.1.

**Figure B.1 – MIG/MAG
torches**

**Figure B.2 – TIG
torches**

**Figure B.3 – Plasma welding
torches**

Annex C
(informative)

Cooled copper block

An example of design of a water-cooled copper block is given in Figure C.1.

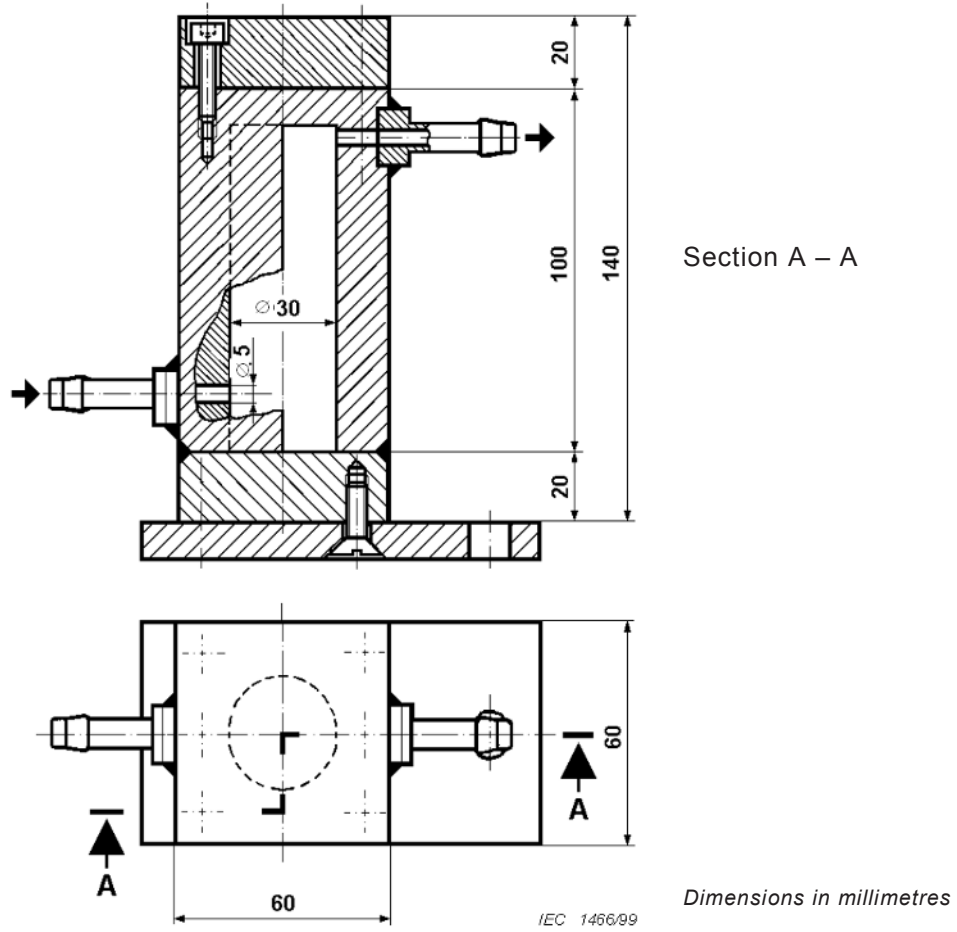


Figure C.1 – Water-cooled copper block – Example

Annex D
(informative)

Copper block with a hole

An example of design of a water-cooled copper block with a hole is given in Figure D.1.

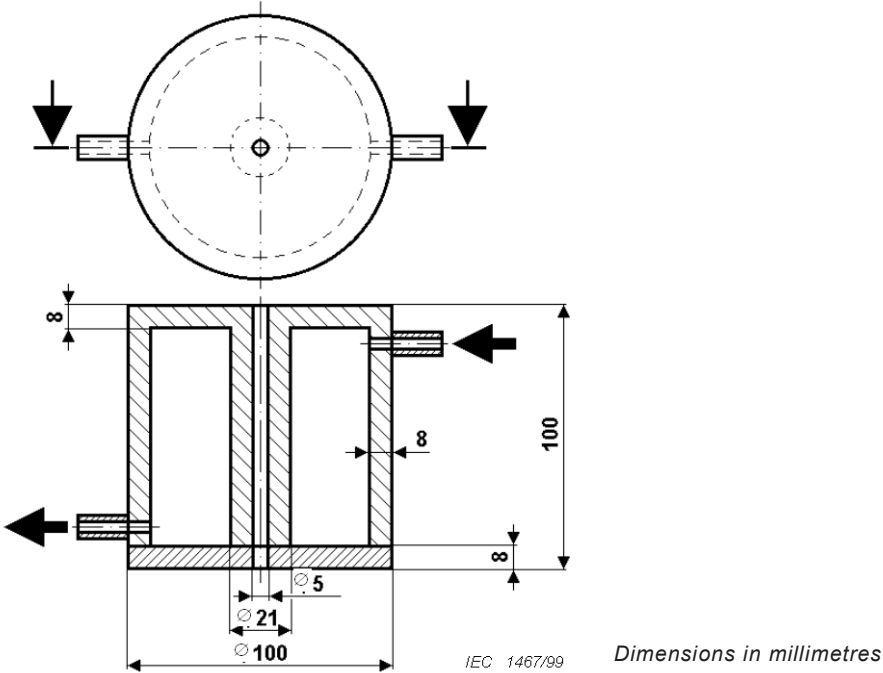
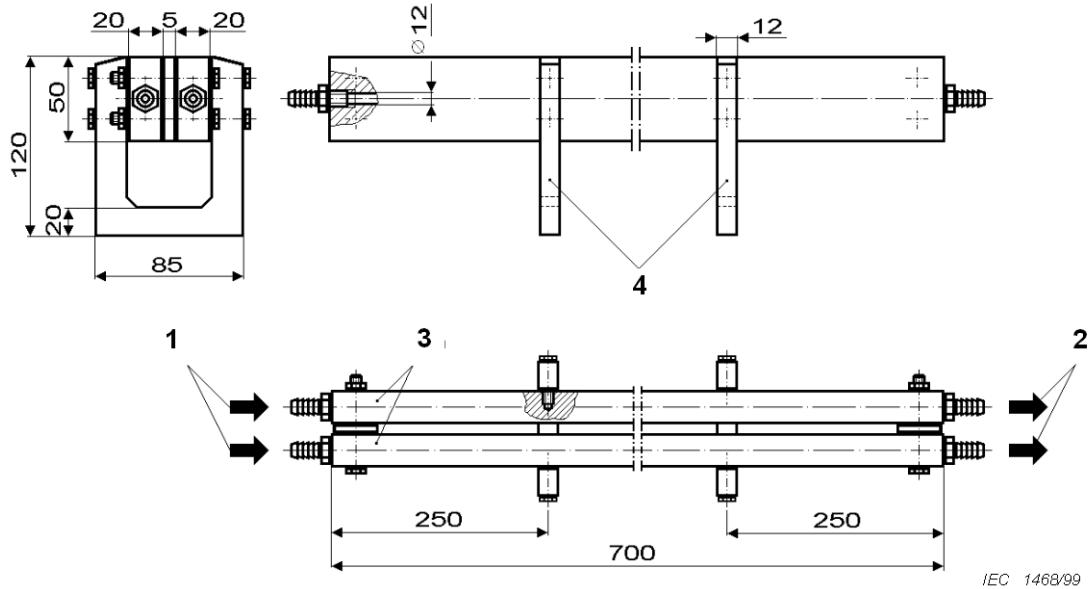


Figure D.1 – Water-cooled copper block with a hole – Example

Annex E (informative)

Copper bars with a slot

An example of design of a water-cooled copper bars with a slot is given in Figure E.1.



Key

- 1 Water inlet
- 2 Water outlet
- 3 Copper bar
- 4 Support

Dimensions in millimetres

Figure E.1 – Water-cooled copper bars with a slot – Example

Bibliography

IEC 60974-2, *Arc welding equipment – Part 2: Liquid cooling systems*

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